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ABSTRACT

Missouri requires the testing of all eighth grade students on their competence in reading and language arts, mathematics, and government and economics. This statewide assessment is referred to as the Missouri Basic Essential Skills Test (BEST) and has been given in the spring of each year since 1978. A study was undertaken to determine which characteristics of school districts correlate most clearly with student success on the BEST tests. The educational production function conceptual model was used. This model assumes that measured school output is a function of students' out-of-school environment, their in-school environment, and peer characteristics. Fifteen predictor variables suited to the model were selected, including financial and demographic characteristics of districts, school sizes and staffing levels, and results of tests of reading and mathematics skills at lower grade levels. Regression analysis revealed that a significant relationship exists between school district characteristics and student performance. Variables of particular importance included number of students of a low socioeconomic background, average daily attendance percentages, reading scores at lower grade levels, assessed valuation in the community, and the urban or rural nature of the district. In-school environmental characteristics proved of little predictive value. (Author/PGD)

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RELATIONSHIPS BETWEEN SCHOOL DISTRICT LEVEL INPUTS AND THE OUTPUT PERFORMANCE OF STUDENTS ON THE MISSOURI BASIC ESSENTIAL SKILLS TEST

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RELATIONSHIPS BETWEEN SCHOOL DISTRICT LEVEL INPUTS AND THE OUTPUT PERFORMANCE OF STUDENTS ON THE MISSOURI BASIC ESSENTIAL SKILLS TEST

Abstract

The present study used the educational production function conceptual model to analyze the relationships between characteristics of school districts and average performance on the Basic Essential Skills Test (BEST) administered annually to all eighth grade students in Missouri. Data on seven output variables and fifteen input variables were collected for all public school districts. The results of multiple regression analyses indicated that significant predictors of BEST performance include scores of younger peers on criterion-referenced reading tests, the urban-rural classification of community, assessed valuation per pupil, average daily attendance, and the number of pupils receiving Aid to Families with Dependent Children. A seven-variable predictive model of educational outcomes is proposed with identified proxy measures of the out-of-school environment, the school environment, and pupil peer characteristics.

RELATIONSHIPS BETWEEN SCHOOL DISTRICT LEVEL INPUTS AND THE OUTPUT PERFORMANCE OF STUDENTS ON THE MISSOURI BASIC ESSENTIAL SKILLS TEST[1]

Within the past decade, the public has begun to demand that schools be accountable for educating students who are literate and who possess necessary skills to survive in a complex society. Educators working with parents, students, legislators, and other interested citizens have been attempting to define the "basic skills" needed for effective citizenship and to determine a defensible manner in which to measure these skills. Economists have assisted in the accountability movement by assessing the equity and efficiency of public education and by drawing parallels and differences between the private and public sectors.

It was apparent, by early 1975, that the movement toward competency-based testing of students in the United States was gaining momentum. By the end of 1979, some form of minimum competency testing for essential skills and knowledge had been mandated in thirty-six states. Missouri is one of those states, requiring the testing of all eighth grade students on their levels of competence in reading/language arts, mathematics, and government/economics. The statewide assessment is referred to as the Missouri Basic Essential Skills Test (BEST) and has been given in the spring of each year since 1978. Average school district scores have varied widely in Missouri's 554 public school districts (454 high school districts and 100 elementary school districts).

The purpose of the study described herein was to determine which characteristics of school districts explain existing BEST results variance and form a basis for predicting average school district performance on the BEST. The educational production function conceptual model was employed to determine what combination of objective data measuring the extent to which (1) the out-of-

school environment of students, (2) the in-school environment, and (3) peer characteristics of students can be associated with performance on a competency-based test of basic skills. This model has been used in previous efforts to explain variances in students' performance on standardized tests. It is of potential importance to determine whether predictors of performance on national standardized tests also evidence predictive power relative to performance on a state's competency-based test. The hypothesis guiding the present study was as follows: There exists no predictive relationship between objective data for Missouri's public school districts and the average percentage per school district of students passing and mastering the statewide objectives of each subtest and passing the total Basic Essential Skills Test.

The intent of input-output studies, such as this one, is to determine which inputs make a difference in school outputs. If certain inputs are significant predictors of output, the next step would be to determine how resources can be allocated differently to provide a greater probability of achieving the outcomes desired by both professional educators and school districts' taxpaying citizens. Obviously, a competency-based test measures only a limited, narrow set of outcomes of public education, but it provides quantified data conducive to policy decision making. Other outcomes such as successful interpersonal relations and general well-being are more difficult to measure.

The educational production function in its general form and meaning is as follows: $O = f(E, S, P)$

WHERE:

O = Output

E = Out-of-school Environment of students

S = Components of the School environment

P = Peer characteristics

In the selection of input or predictor variables it was important to find proxies which met the following conditions: (1) had the ability to measure different kinds of educational inputs; (2) were easily quantifiable; (3) were publicly accessible; (4) had theoretical and/or empirical foundations, as suggested by prior research results which are discussed later in the section of this paper describing the study's theoretical framework; and (5) were appropriate for use in the conceptual model. Based on the above considerations, the fifteen variables reported and described in Table 1 were selected to represent the three types of inputs.

THEORETICAL FRAMEWORK

During the last few decades, paper-and-pencil tests have become the most pervasive, reliable way to measure the attainment of educational goals in the schools, largely because these test scores are amendable to identification and quantitative analysis. Since the mid 1950's, researchers have attempted to correlate inputs and outputs in education. By the mid 1960's, educational production function models had found their way into the literature. Of the approximately three dozen major, nationally recognized educational production function studies cited in literature reviews, all but one used reading, verbal, and/or mathematics achievement tests and batteries of tests as the measurement of school output. When multiple outputs were studied, researchers have included measurements of student attitudes, aspirations, and continuation of education.[2]

Jencks[3] cast doubt on the use of test scores as a measure of any long-term educational goal since he concluded that genes and environment, rather than quality of schooling, led to economic success. He did believe that well-financed, competently administered schools have a short-term "happiness" effect on the lives of children and staff. Yet educators and the public continue to demand higher test scores in the belief that several long-term social goals can be

Table 1

Production Function Test Model for Missouri School District Outcomes on the Basic Essential Skills Test

Formula: O = f (IF, UR, RM, FAV, TL, AS, CL, PSR, CE, AM, ADC, FR, FM, SR, SM)

Where:

IF = Income Factor used in Missouri for calculating the school foundation aid formula, derived from dividing the average family income per school district by the average family in the state

UR = Seven-cell Urban-Rural classification of school districts, based on population and whether the district is classified as being part of a Standard Metropolitan Statistical Area by the Bureau of the Census

RM = Resident Membership within the school district, the number of students

FAV = Adjusted Formula Assessed Valuation per eligible pupil

TL = Total school district Tax Levy, including debt service

AS = Average Salary per school district certificated personnel

CL = Four-cell Classification of school districts by the Missouri Department of Elementary and Secondary Education, using several measures of quality

PSR = Pupil/Staff Ratio, calculated by dividing the resident pupil membership by the number of certificated personnel in the district

CE = Current Expenditures per eligible pupil in the district

AM = Average daily Attendance divided by average daily Membership, resulting in an index of pupil attendance and, correspondingly, of pupil absences

ADC = Number of pupils enrolled in the district who receive state Aid to families with Dependent Children, a factor built into the Missouri school foundation aid formula based on assumed needs for compensatory education programming

FR = Average percent of correct responses on the Missouri statewide Fourth grade criterion-referenced Reading assessment, serving as a proxy measure of pupil peer characteristics

FM = Average percent of correct responses on the Missouri statewide Fourth grade criterion-referenced Mathematics assessment, serving as a proxy measure of pupil peer characteristics

SR = Average percent of correct responses on the Missouri statewide Sixth grade criterion-referenced Reading assessment, serving as a proxy measure of pupil peer characteristics

SM = Average percent of correct responses on the Missouri statewide Sixth grade criterion-referenced Mathematics assessment, serving as a proxy measure of pupil peer characteristics

achieved by young people who have had the opportunities to succeed in school. Fortunately, research during the mid and late 1970's gives administrators clues about ways to improve test scores through optimum resource allocation.

The out-of-school environment of students has consistently accounted for variance in test scores. Thomas[4] found median family income, median years of adult schooling in the town, percent of owner-occupied homes, and quality of housing to be significant predictors of high school achievement. Coleman[5] determined that an average of 10 percent to 25 percent of the variance in verbal achievement scores for a large national sample of students could be accounted for by socio-economic indices. Subsequent researchers[6] have reanalyzed Coleman's data and have criticized his methodology and conclusions, frequently finding significant in-school predictors overlooked due to Coleman's use of intercorrelated proxies and modest statistical techniques. Boardman,[7] using more sophisticated statistical procedures, nevertheless concluded that Coleman's socio-economic index had a consistent, positive effect on achievement.

Hettick[8] and Dugan[9] found that family income was a significant predictor of standardized test scores, and Winkler[10] found a composite score of cultural items in the home to be a powerful test score predictor. Composite achievement scores were shown to be positively related to a socio-economic index in Goodman's study.[11] Goodman also determined that large cities had the lowest achievement while small cities and suburbs had higher scores than rural-centered schools. Kiesling[12] found no positive relationship between size of a school district and student performance. However, Brown and Saks[13] discovered, when studying the rural-urban classification of school districts, that only the number of students in the rural-town districts was a significant predictor and this was inversely related to achievement.

Dozens of proxies have been used to measure the in-school environment of students. A significant variable in one study may not be significant in another

similar study. Average salary of certificated personnel, teacher quality and years of experience, and the number of administrators and specialists and their pay scales have all been considered proxy measures of school district quality. Raymond[14] found that teacher salary predicted student preparation for higher education, as measured by high school students' college entrance examination scores and grade point averages of college freshmen. Bowles and Levin[15] and Cohn[16] also found average teacher salary to be significantly related to achievement of tenth and twelfth grade students. Teacher experience was found to be positively related to achievement in studies by Burkhead,[17] Klitgaard and Hall,[18] Katzman,[19] and Brown and Saks.[20] However, Guthrie,[21] Hanushek,[22] Murnane,[23] and Wolfe[24] found that teacher experience was a significant predictor of achievement only with particular subsets of students or only during the first few years of the teachers' experience.

Current expenditures per pupil and pupil/teacher ratio do not present any consistent pattern of variable predictive potential in the literature. Prior to 1966, research frequently reported current expenditures as being significantly related to student achievement.[25] However, more recent research has not corroborated earlier findings, possibly because the expenditure measures do not distinguish between costs due to inefficiency and costs leading to higher quality. Wolfe[26] found in Philadelphia that, while cost per pupil was not directly tied to achievement gains, systematic program budget increases and decreases can impact on these gains. Boardman[27] determined that the pupil/teacher ratio is strongly and positively related to achievement, but Glass's[28] recent review indicates that there are no differences in student achievement in the range of ratios exceeding twenty students per class. Pupil/teacher ratio was also suggested as a significant variable in studies by Burkhead[29] and Wolfe.[30] Classroom and school building overcrowding was found to be associated with lower levels of student achievement in a study by Katzman.[31]

Common proxy measures for peer characteristics have been the percentage of non-whites in the school, percentage of over or under achievers, percentage of students from low socio-economic backgrounds, percentage of student turnover, and percentage of students in average daily attendance. When pupil-specific, rather than aggregate, measures of outputs have been used, several socio-economic measures have been considered to be justifiable proxies for peer characteristics. It is uncommon in the literature to find the percentage of students receiving Aid to Families with Dependent Children used as a proxy, and it is also uncommon to find achievement scores of other students used to measure peer characteristics. Nevertheless, suggestions have been made by Michelson[32] to indicate that average school scores at one grade level may not be so very different from average scores at another grade level, particularly if there is little teacher turnover and if the characteristics of pupils in a school district remain fairly constant over a few years.

Due in part to the overall decline in student scores on standardized tests such as the Iowa Tests of Basic Skills and the Scholastic Aptitude Test, the public has sought new methods of measuring the outcomes of formalized schooling. Some groups trace the rise of the minimum competency-basic skills movement back to the 1955 publication of Flesch's book, Why Johnny Can't Read. People gradually became increasingly concerned about excellence, competence, and efficiency in public schooling. The rapid rise of state mandated competency testing in the mid 1970's raised several important questions about whether these tests will actually contribute to realization of the underlying goal of raising the skill levels of students.

Dozens of articles suggest that states have not come to terms with major questions involving what competencies to measure, how and when to measure them, what to do with the "incompetents," whether or not the minimum standard replaces maximum achievement, and whether these tests have a positive or negative impact

upon the overall curriculum of schools. The debate over minimum competency testing will likely continue for the next few years.[33] However, there is growing evidence in Missouri that the public is making judgments about school systems based upon student scores on the Basic Essential Skills Test and that several school districts are making changes in their curricula in order to more adequately prepare their students for the test.

The present study was an attempt to account for the variance in school district scores on the BEST and to serve as a basis for further evaluation of educational resource allocation within the state and within the individual school districts. Yet, it is important in any analysis of education to keep in mind the caveat offered by the National School Boards Association: "We must not lose sight of the big picture: Testing should be understood as but one element of evaluation; evaluation as one component of schooling; schooling as one component of learning; and learning but one component of improvement of society."[34]

METHOD

Data source. All public school districts in Missouri participated in the testing of all their eligible eighth graders using the Basic Essential Skills Test (BEST) in the spring of 1979. Pupils who were considered ineligible for inclusion were those whose IEP's (Individualized Instructional Programs, developed in compliance with Public Law 94-142) indicated that the BEST was unsuited for their abilities and needs. The number of pupils tested was estimated to be approximately 70,000, enrolled in 554 public school districts. Missing data on various independent variables reduced the maximum number of possible observations for the present study to 544. Data were collected from the files of various divisions of the Missouri Department of Elementary and Secondary Education.

Instrumentation. Demographic data were used for eleven of the predictor variables. Test instruments provided the data for the seven criterion variables and four of the fifteen predictor variables. The three test instruments used in this study were all designed to be criterion referenced tests developed to measure competencies valued by the citizens of Missouri. Reliability and validity measures have not been calculated for any of the instruments.

The Basic Essential Skills Test (BEST) provided the data for the seven criterion variables measuring one type of school district output. The rationale for the development of the BEST was based on the mastery of the following minumum skills: (1) ability to read newspapers and magazines and to use the English language effectively in speaking and writing; (2) ability to perform basic arithmetic computations and to use these in consumer situations; and (3) ability to participate effectively in government and consumer processes by understanding government and its functions and basic economic principles.[35] Each of the three subtests of the BEST is composed of a thirty-nine item multiple choice test measuring thirteen objectives developed by educators and lay citizens of Missouri. Pilot testing occurred in the spring of 1977. Up to this time, there has been no serious attempt to require a passing grade on the BEST to qualify for a high school diploma.

The BEST is one element in the total statewide criterion-referenced testing program. Data for the fourth and sixth grade assessments were used to measure the peer characteristics in the conceptual model. The Fourth Grade Criterion-Referenced Test was administered in the fall of 1978. Each of the two subtests, Reading and Mathematics, has thirty objectives with three test items for each objective. The Sixth Grade Criterion-Referenced Test was administered in the spring of 1979. There are two subtests, Reading and Mathematics, with three test items designed to measure each of fifteen objectives

for each subtest. The average percentage of correct responses per school district on each subtest of these two criterion-referenced tests was used as a predictor variable.

Analysis. Multiple regression analysis was selected for its ability to account for variance in the dependent variables and for its ease in interpretation. Specifically, the Statistical Analysis System (SAS)[36] computer package was used because it offered the Maximum R^2 (MAXR) Improvement Technique as an option within the multiple regression stepwise procedure. The MAXR method selects the one-variable model producing the highest R^2, followed by another variable yielding the greatest increase in R^2. Comparisons are made following each addition, and one variable may be removed and replaced if the new combination results in a higher R^2. All possible predictor variable manipulations are evaluated before any changes are made.

SAS computer analysis printouts report the estimated partial regression coefficients for each predictor variable. These are especially important because it gives policy makers an estimate of the magnitude of change possible in the criterion variable through manipulation of independent variables. For example, if $Y = (2.50\ X_1) + (.50\ X_2)$, policy makers could estimate that a one unit increase in X_1 would theoretically result in a 2.50 increase in Y when X_2 is held constant or controlled for. Likewise, an increase of one unit in X_2 would result in a .50 change in Y. Clearly, given this option, a policy maker would prefer increasing X_1, if at all possible and if the costs of increasing X_1 and X_2 were the same.

In this exploratory study, there was no basis for the use of simultaneous equations and the two-stage least squares procedures frequently used by economists in production function studies. In future studies of BEST results, it may be beneficial to experiment with simultaneous models and more sophisticated

statistical techniques. For the present study, because of the ease of interpretation provided, the Maximum R^2 improvement regression technique appeared to be the most defensible, potentially useful, and robust form of analysis.

A separate regression equation was computed for each of the seven criterion variables, these being the percentage of students passing and mastering the BEST Reading/Language Arts subtest, the Mathematics subtest, the Government/Economice subtest and the percentage passing to all three BEST subtests. Table 2 is presented to report means and standard deviations for each of the seven dependent or criterion variables and the fifteen possible independent or predictor variables.

A t-test to determine equality of means on all dependent and independent variables was computed for the purpose of generalizing the results of the fifteen variable model to all Missouri school districts. School districts which did not administer the fourth and sixth grade criterion referenced tests did not differ significantly in performance on any of the dependent variables. They differed in only two of the independent variables. Districts which did not administer both tests exhibited: (1) a significantly higher formula assessed valuation per eligible pupil than the districts which administered the tests; and (2) a significantly lower district classification rating by the Missouri Department of Elementary and Secondary Education.

REGRESSION ANALYSIS RESULTS

Regression analysis was used to determine the extent to which a linear combination of fifteen variables measuring the out-of-school environment of students, the in-school environment, and peer characteristics explains and has potential for predicting student performance on the Basic Essential Skills Test (BEST). A separate regression equation was computed for each of the seven

Table 2

Descriptive Statistics for Variables in the Study

Variable, by Category	Mean*	Standard Deviation
Dependent Variables, Outcomes on the Basic Essential Skills Test:		
Percent Passing Reading/Language Arts Subtest	89.158	8.942
Percent Mastering Reading/Language Arts Subtest	69.915	12.693
Percent Passing Mathematics Subtest	73.595	13.346
Percent Mastering Mathematics Subtest	51.184	15.801
Percent Passing Government/Economics Subtest	77.865	12.596
Percent Mastering Government/Economics Subtest	53.312	14.134
Percent Passing All BEST Subtests	65.260	15.134
Independent Variables, Included in the Production Function Model:		
Income Factor (1 = State Average)	0.907	0.098
Urban-Rural (1 + Large Urban , 7 = Small Rural)	5.942	1.585
Resident Membership, Enrollment	1,600.992	1,482.109
Formula Assessed Valuation per Eligible Pupil	21,486.490	10,109.601
Total Tax Levy (per $100 Assessed Valuation)	4.058	0.613
Average Teacher Salary	10,666.523	2,144.144
Classification (3 = AAA, 0 = Unclassified)	2.016	0.887
Pupil/Staff Ratio	15.905	5.052
Current Expenditure per Pupil Enrolled	1,284.384	246.276
Pupil Attendance as Percent of Pupil Membership	93.105	2.722
Number of Pupils Receiving Aid to Families with Dependent Children	185.301	1,613.344
District Average of Correct Student Responses on Missouri Criterion-Referenced Statewide Tests		
Fourth Grade Reading	61.729	6.648
Fourth Grade Mathematics	59.663	6.516
Sixth Grade Reading	67.987	5.381
Sixth Grade Mathematics	55.201	7.369

*The number of school districts included in the descriptive statistics analyses differs across variables due to missing data for some districts on some variables. For example, data were available from 549 districts in the population of 554 districts on BEST results, but from only 288 districts on the statewide fourth grade tests. Prior to regression analyses, t statistics were used to test for equality of means on independent and dependent variables across district groupings as a way to establish a basis for making appropriate comparisons across the regression results and to consider the efficacy of the education production function models.

criterion variables, resulting in variations in the number of districts included in the analyses ranging from N = 544 to N = 521 to N = 244. The greatest drop in the number of districts for production function model testing occurred because the fourth and sixth grade criterion referenced tests are not required by the state education agency each year. A total of 366 school districts administered the sixth grade assessment; only 288 districts administered the fourth grade assessment; and only 244 districts administered both. The researchers decided that three separate regression equations would be computed for each of the seven dependent variables, using districts for which appropriate data were available as follows: (1) the complete model with all fifteen predictor variables, producing an N of 244; (2) a model eliminating the fourth and sixth grade scores, thus containing eleven variables, producing an N of 544; and (3) a model using the above eleven predictor variables, eliminating the two large urban school districts and the twenty-one smallest districts with fewer than 100 pupils enrolled, producing an N of 521. This third model was employed in an attempt to control for the possible unique variable differentials of very small districts and the possible bias introduced by the inclusion of the two largest urban districts (Kansas City and St. Louis).

Summaries of regression analysis results are presented in Tables 3 through 6. All twenty-one regression equation $\underline{F}$ ratios were significant at the .0001 level. The total R^2 is reported to illustrate the total amount of variance accounted for by the production function model as specified. The more important R^2 is the one reported for each model containing only significant predictors. For example, in Table 3, a linear combination of five variables (urban-rural classification of the district, pupil/staff ratio, number of pupils receiving Aid to Families with Dependent Children, fourth grade reading score, and sixth grade reading score) accounts for slightly over 23 percent of the variance in the dependent variable measuring the percentage of students per school district

Table 3

Summary of Regression Analyses for Predicting the Percentage of Students Passing and Mastering the Reading/Language Arts Subtest of the Basic Essential Skills Test (BEST) in Missouri Public School Districts

Predictor Variables and Selected Exhibits	Partial Regression Coefficient, by Group and Criterion (Reported Only for Significant Variables in the Model)					
	Group 1 (N=544)*		Group 2 (N=521)*		Group 3 (N=244)*	
	Pass	Master	Pass	Master	Pass	Master
Exhibit: Stepwise Regression Intercept	92.480	21.293	68.196	34.063	55.018	- 2.790
Predictor Variables:						
Income Factor	--	--	--	--	--	--
Urban-Rural Class.	- 1.007	- 1.715	- 1.274	- 1.721	- 1.017	--
Resident Membership	--	--	0.000	0.001	--	--
Assessed Valuation	0.000	0.000	0.001	0.000	--	0.000
Total Tax Levy	--	--	--	--	--	--
Average Salary	--	--	--	--	--	--
School Classification	--	--	--	--	--	--
Pupil/Staff Ratio	--	--	--	--	0.223	--
Current Expenditures	--	--	--	--	--	--
Avg. Daily Attendance	--	0.588	0.269	0.437	--	--
Aid Dependent Children	- 0.001	- 0.001	- 0.011	- 0.015	- 0.010	--
Statewide Tests:						
4th Grade Reading	n.a.	n.a.	n.a.	n.a.	0.200	--
4th Grade Math	n.a.	n.a.	n.a.	n.a.	--	0.309
6th Grade Reading	n.a.	n.a.	n.a.	n.a.	0.370	0.742
6th Grade Math	n.a.	n.a.	n.a.	n.a.	--	--
Stepwise Regression Summary:						
Total Model R^2	.060	.102	.125	.163	.234	.260
df	3/540	4/539	5/515	5/515	5/238	3/240
F Ratio (All .05 Sig.)	17.26	25.99	14.23	16.90	7.60	6.19
Exhibit: Multiple Regression Summary						
Total Model R^2	.077	.113	.134	.169	.252	.313
df	11/532	11/532	11/509	11/509	15/228	15/228
F Ratio (All .05 Sig.)	4.02	6.16	7.16	9.39	5.13	6.92

*Group 1 includes the 544 districts for which data were available from the population of 554 districts. Group 2 represents the 544 districts, minus the 2 largest and those 21 districts with student enrollments under 100. Group 3 represents the 244 districts from the 544 for which data were available on statewide tests given to fourth and sixth grade students. Hence, for Groups 1 and 2, "n.a." indicates data were not available and not considered in the regression model analyses.

passing the Reading/Language Arts subtest. In the stepwise procedure used, the sixth grade reading score emerged as the single more powerful predictor for passing and mastering the Reading/Language Arts subtest of the BEST. The addition of the ten remaining independent variables produced a trivial increase in explanatory power. This same pattern can be observed in the final exhibit section of Tables 3, 4, 5, and 6 reporting regression analysis summaries. That is, the stepwise regression equations explain variance within limited variable models as robustly as do the multiple regression linear equations with their increased numbers of independent variables.

The magnitude of the R^2 is greatly reduced when fourth and sixth grade scores are not available. Only 6.01 percent of the variance is accounted for by a linear combination of urban-rural classification, assessed valuation, and the number of pupils receiving ADC. The income factor was the best single predictor, but it was replaced in the three-variable model by the combination of other predictors. As variables combine, the predictive power of individual variables changes. This replacement of the income factor occurred in all seven regressions in which it was shown to be an important predictor. By eliminating the small/large school district extremes, the percent of explained variance in passing Reading/Language Arts for the 521 remaining districts increased to 12.5 percent with the addition of resident membership (district size) and percent of resident membership in average daily attendance. As expected, the urban-rural classification and the number of pupils receiving ADC carry negative signs for the partial regression coefficients. Unexpected was the positive sign exhibited by the coefficient of the pupil/staff ratio.

Students are said to have passed each subtest when they answer 75 percent of the items correctly and have at least one of the three items correct on each subtest objective. Mastery requires that 80 percent of the items be correct, with at least two of the three items correct for each objective. As shown in

Table 3, the fourth grade math score was included in the combination of significant variables for predicting mastery of the Reading/Language Arts subtest. The variance explained for mastery of the subtest was 10.2 percent for the 544 district model, 16.3 percent for the 521 district model, and 26.0 percent for the 244 district model. Throughout the study, the greatest amount of variance is accounted for by the models including the fourth and sixth grade tests, and the least amount is accounted for when the small/large school district extremes are included.

Performance on the Mathematics subtest is presented in Table 4. The same variables which emerged as important predictors of performance on the Reading/Language Arts subtest were shown to be important predictors on the Mathematics subtest also, these being: urban-rural classification, assessed valuation, pupil/staff ratio, average daily attendance, number of pupils receiving ADC, and the sixth grade reading score. In addition, average salary per certificated personnel was significant for the mastery criterion when all school districts (N = 544) were included. Within the analysis for the reduced number of 244 districts for which data were available on all fifteen model variables, the fourth grade reading score surfaced as a significant predictor of Mathematics mastery. Surprisingly, the fourth and sixth grade mathematics scores were not significant predictors. The variance accounted for ranged from 11.6 percent to 30.5 percent. When available, the sixth grade reading score was the single most important predictor of both the criterion of passing and the criterion of mastering the BEST Mathematics subtest. When sixth grade reading assessment results were unavailable, the assessed valuation per eligible pupil became the most powerful predictor.

The results of six stepwise regression analyses for the Government/Economics subtest are summarized in Table 5. The significant predictors remain essentially the same as in the twelve previous equations. Resident membership

Table 4

Summary of Regression Analyses for Predicting the Percentage of Students Passing and Mastering the Mathematics Subtest of the Basic Essential Skills Test (BEST) in Missouri Public School Districts

Predictor Variables and Selected Exhibits	Partial Regression Coefficient, by Group and Criterion (Reported Only for Significant Variables in the Model)					
	Group 1 (N=544)*		Group 2 (N=521)*		Group 3 (N=244)*	
	Pass	Master	Pass	Master	Pass	Master
Exhibit: Stepwise Regression Intercept	- 8.118	-47.658	- 1.691	-19.961	-51.229	-38.264
Predictor Variables:						
Income Factor	--	--	--	--	--	--
Urban-Rural Class.	- 1.513	--	- 1.691	- 2.651	- 1.549	--
Resident Membership	--	--	--	--	--	--
Assessed Valuation	0.000	0.000	0.000	0.000	0.000	--
Total Tax Levy	--	--	--	--	--	--
Average Salary	--	0.002	--	--	--	--
School Classification	--	--	--	--	--	--
Pupil/Staff Ratio	--	--	--	--	0.736	0.727
Current Expenditures	--	--	--	--	--	--
Avg. Daily Attendance	0.908	0.803	0.892	0.859	0.808	--
Aid Dependent Children	- 0.001	- 0.001	- 0.011	- 0.011	- 0.014	--
Statewide Tests:						
4th Grade Reading	n.a.	n.a.	n.a.	n.a.	--	0.427
4th Grade Math	n.a.	n.a.	n.a.	n.a.	--	--
6th Grade Reading	n.a.	n.a.	n.a.	n.a.	0.679	0.774
6th Grade Math	n.a.	n.a.	n.a.	n.a.	--	--
Stepwise Regression Summary:						
Total Model R^2	.126	.116	.158	.153	.305	.235
df	4/539	4/539	4/516	5/516	6/237	3/240
F Ratio (All .05 Sig.)	18.72	23.11	31.71	32.44	8.73	15.79
Exhibit: Multiple Regression Summary						
Total Model R^2	.134	.121	.171	.164	.327	.299
df	11/532	11/532	11/509	11/509	15/228	15/228
F Ratio (All .05 Sig.)	7.49	6.71	9.57	9.08	7.37	6.48

*Group 1 includes the 544 districts for which data were available from the population of 554 districts. Group 2 represents the 544 districts, minus the 2 largest and those 21 districts with student enrollments under 100. Group 3 represents the 244 districts from the 544 for which data were available on statewide tests given to fourth and sixth grade students. Hence, for Groups 1 and 2, "n.a." indicates data were not available and not considered in the regression model analyses.

Table 5

Summary of Regression Analyses for Predicting the Percentage of Students Passing and Mastering the Government/Economics Subtest of the Basic Essential Skills Test (BEST) in Missouri Public School Districts

Predictor Variables and Selected Exhibits	Partial Regression Coefficient, by Group and Criterion (Reported Only for Significant Variables in the Model)					
	Group 1 (N=544)*		Group 2 (N=521)*		Group 3 (N=244)*	
	Pass	Master	Pass	Master	Pass	Master
Exhibit: Stepwise Regression Intercept	38.210	-15.319	30.141	-25.435	33.883	18.522
Predictor Variables:						
Income Factor	--	--	--	--	--	--
Urban-Rural Class.	- 1.501	- 2.313	- 1.645	- 2.437	- 1.396	- 2.539
Resident Membership	--	--	0.001	0.001	--	--
Assessed Valuation	0.000	0.000	0.000	0.000	--	--
Total Tax Levy	--	--	--	--	--	--
Average Salary	--	--	--	--	--	--
School Classification	--	--	--	--	--	--
Pupil/Staff Ratio	--	0.277	0.235	0.326	0.388	--
Current Expenditures	--	--	--	--	--	--
Avg. Daily Attendance	0.480	0.769	0.535	0.878	--	--
Aid Dependent Children	- 0.001	- 0.001	- 0.016	- 0.016	- 0.016	- 0.017
Statewide Tests:						
4th Grade Reading	n.a.	n.a.	n.a.	n.a.	0.397	0.341
4th Grade Math	n.a.	n.a.	n.a.	n.a.	--	--
6th Grade Reading	n.a.	n.a.	n.a.	n.a.	0.349	0.441
6th Grade Math	n.a.	n.a.	n.a.	n.a.	--	--
Stepwise Regression Summary:						
Total Model R^2	.076	.131	.142	.192	.257	.234
df	4/539	5/538	6/514	6/514	5/238	4/239
F Ratio (All .05 Sig.)	19.49	38.70	14.73	26.07	7.75	17.97
Exhibit: Multiple Regression Summary						
Total Model R^2	.089	.142	.145	.199	.283	.274
df	11/532	11/532	11/509	11/509	15/228	15/228
F Ratio (All .05 Sig.)	4.72	7.99	7.83	11.51	6.00	5.74

*Group 1 includes the 544 districts for which data were available from the population of 554 districts. Group 2 represents the 544 districts, minus the 2 largest and those 21 districts with student enrollments under 100. Group 3 represents the 244 districts from the 544 for which data were available on statewide tests given to fourth and sixth grade students. Hence, for Groups 1 and 2, "n.a." indicates data were not available and not considered in the regression model analyses.

becomes a significant predictor when the large and small districts are excluded (reducing the N of 544 to 521). In general, larger school districts in less rural areas have higher percentages of students passing the Government/Economics subtest. The variance accounted for through stepwise regression equations ranged from 7.6 percent (with passing as the criterion, N = 544) to 25.7 percent (again, with passing as the criterion, N = 244).

The percentage of students per school district mastering the composite of all three subtests of the BEST was not reported by the Missouri Department of Elementary and Secondary Education. Table 6 presents the regression summary for students passing all three subtests. Explained variance ranged from 12.1 percent (N = 544 districts) to 18.9 percent (N = 521) to 32.1 percent (N = 244). The seven-variable stepwise equation for the model explaining the highest percent of variance included: urban-rural classification, assessed valuation, pupil/staff ratio, average daily attendance, number of pupils receiving ADC, the fourth grade reading score, and the sixth grade mathematics score. The partial regression coefficients suggest that one unit increase in the percentage of students in average daily attendance is associated with an increase of almost one unit in the average percentage of students passing the total BEST.

Since the F Ratios for all twenty-one regression equations were significant, the research hypotheses is rejected in favor of the alternative: A significant relationship exists between objective data for Missouri's public school districts and the average percentage per school district of students passing and mastering the statewide objectives of each subtest and passing the total Basic Essential Skills Test.

DISCUSSION

The conceptualization for the present study was that of an educational production function model, as illustrated in Table 1. The test model included

Table 6

Summary of Regression Analyses for Predicting the Percentage of Students Passing All Three Subtests of the Basic Essential Skills Test (BEST) in Missouri Public School Districts

Predictor Variables and Selected Exhibits	Partial Regression Coefficient, by Group and Criterion (Reported Only for Significant Variables in the Model)		
	Group 1 (N=544)* Pass Total BEST	Group 2 (N=521)* Pass Total BEST	Group 3 (N=244)* Pass Total BEST
Exhibit: Stepwise Regression Intercept	-12.592	-31.551	-54.478
Predictor Variables:			
Income Factor	--	--	--
Urban-Rural Class.	- 1.935	- 2.635	- 2.183
Resident Membership	--	--	--
Assessed Valuation	0.000	0.000	0.000
Total Tax Levy	--	--	--
Average Salary	--	--	--
School Classification	--	--	--
Pupil/Staff Ratio	--	0.269	0.679
Current Expenditures	--	--	--
Avg. Daily Attendance	0.890	1.091	0.880
Aid Dependent Children	- 0.001	- 0.013	- 0.017
Statewide Tests:			
4th Grade Reading	n.a.	n.a.	0.359
4th Grade Math	n.a.	n.a.	--
6th Grade Reading	n.a.	n.a.	--
6th Grade Math	n.a.	n.a.	0.307
Stepwise Regression Summary:			
Total Model R^2	.121	.189	.321
df	4/539	5/515	7/236
F Ratio (All .05 Sig.)	24.33	39.06	15.49
Exhibit: Multiple Regression Summary			
Total Model R^2	.127	.198	.333
df	11/532	11/509	15/228
F Ratio (All .05 Sig.)	7.05	11.43	7.57

*Group 1 includes the 544 districts for which data were available from the population of 554 districts. Group 2 represents the 544 districts, minus the 2 largest and those 21 districts with student enrollments under 100. Group 3 represents the 244 districts from the 544 for which data were available on statewide tests given to fourth and sixth grade students. Hence, for Groups 1 and 2, "n.a." indicates data were not available and not considered in the regression model analyses. Data were not available for percentage of students mastering all three BEST subtests.

fifteen independent variables to be considered as having potentially functional influences on school district outcomes, herein defined as student performance in terms of passing or mastering the various subtests of the Missouri Basic Essential Skills Test. On the basis of the composite results of statistical analyses conducted by the researchers, a reconceptualized production function model for student performance on the BEST in Missouri public school districts is proposed in Table 7. This model is presented as a parsimonious synthesis of the twenty-one separate stepwise regression analyses. The original test model has been reduced from fifteen to seven potentially powerful explanatory/predictive variables, within the following conceptual categories: (1) proxy measures of the out-of-school environment, two variables; (2) proxy measures of the in-school environment, two variables; and (3) proxy measures of pupil peer characteristics, three variables. The discussion which follows addresses not only supportive bases for the reconceptualized model but also some of the researchers' continuing concerns about any attempts to globally generalize from the model and its several discrete components.

The educational production function model specified in this study used measures of cross-sectional aggregate data. As expected, this kind of average data collected for only one period of time could not explain all of the variance in student performance on Missouri's Basic Essential Skills Test. Even though only approximately one-fourth to one-third of the variance was accounted for, five general conclusions seem appropriate: (1) All potentially significant explanatory predictor variables associated with the out-of-school environment, the in-school environment, and peer characteristics were not included in the model employed in the present study. (2) Using an entire school district as the unit of observation produces statistically significant, but not necessarily highly practical, regression analysis R^2 results. Greater variance may be accounted for by using pupil-specific data in which the pupil is the unit of ob-

Table 7

Reconceptualized Production Function Model for Missouri School District Outcomes on the Basic Essential Skills Test (BEST): A Parsimonious Synthesis from the Stepwise Regression Analyses

Formula: O = f (UR, FAV, PSR, AM, ADC, FR, SR)

Where:

As specific measure(s) of outcomes

O = Either (a) the percentage of students passing the total BEST or any of its three subtests or (b) the percentage of students mastering any of the three BEST subtests

As proxy measures of the out-of-school environment

UR = Seven-cell Urban-Rural classification of school districts, based on population data and whether the district is classified by the Bureau of the Census as being part of a Standard Metropolitan Statistical Area (1 = Large Urban, . . . 7 = Small Rural)*

FAV = Adjusted Formula Assessed Valuation per eligible pupil**

As proxy measures of the school environment

PSR = Pupil/Staff Ratio, calculated by dividing the resident pupil membership by the number of certificated personnel in the district**

AM = Average daily Attendance divided by average daily Membership, resulting in an index of pupil attendance**

As proxy measures of pupil peer characteristics

ADC = Number of pupils enrolled in the district who receive state Aid to families with Dependent Children, a factor built into the Missouri school foundation aid formula based on assumed special needs for compensatory education programming*

FR = Average percent of correct responses on the Missouri statewide Fourth grade criterion-referenced Reading assessment**

SR = Average percent of correct responses on the Missouri statewide Sixth grade criterion-referenced Reading assessment**

*The lower the "score" on this measure, the higher the predicted outcome(s).

**The higher the "score" on this measure, the higher the predicted outcome(s).

servation. When this is not possible, a school building, rather than a district, might be a better unit of observation. (3) Due to the aggregate nature of the data, no characteristics of the in-school environment of students actually described any part of the "process" of education. For example, types of instructional techniques, actual size of classes, variety of educational experiences, and school climate could be considered measures of the process of education. (4) The model specified did determine that several peer characteristics and out-of-school characteristics were highly significant predictors of district averages of students on the BEST. (5) The educational production function is an appropriate model for use with minimum competency testing results as the output. The amount of variance accounted for does not differ greatly from that of other aggregate studies using standardized tests as the output proxies.

All dependent variables were measures of average performance on the subtests of the BEST, and these seven variables were highly intercorrelated. Separate analyses of these data revealed that between-subtests correlations ranged from +.560 to +.899. The characteristics of school districts which help to predict performance on one subtest are generally the same characteristics which predict performance on another subtest. Moreover, these characteristics are very similar for predicting passing and mastering of a subtest. No pattern of differences emerges.

Although there was no attempt to analyze the content of the BEST, two characteristics which are significant predictors cannot be dismissed lightly. Districts with large numbers of economically deprived children, as measured by the number of pupils receiving Aid to Families with Dependent Children, and districts in small rural communities have lower average performance than other districts. This could be attributed to fewer educational advantages in the homes and communities in which the children live. It could also mean that the BEST does not measure skills which are reinforced in these homes and communities. It is even

possible that some of the basic skills measured by the BEST are skills which are not highly valued in low-wealth and rural communities. These comments about content of the BEST are in no way meant to be data-based conclusions of this study. Rather, they represent plausible explanations which need to be explored, based upon the results of the present study.

Peer characteristics are highly important predictors of student performance. As expected, the number of students within a school district who have low socio-economic backgrounds, as measured by the ADC figures, is significally associated with low BEST performance in nineteen of the twenty-one regression equations. This finding substantiates the conclusions of Winkler[37] and also Summers and Wolfe.[38] Winkler found that the proportion of peers of a low socio-economic status was related to sixth and eighth grade students' scores on the Standard Grading Test. Summers and Wolfe found that elementary schools in Philadelphia with high proportions of low-income students had more low achievers and fewer high achievers than did the other elementary schools.

High performance on the BEST is associated with a high percentage of students in average daily attendance within the entire district. This study supports findings of Walstad[39] and Huff[40] in their independent investigations of BEST results. It is possible that districts characterized by high attendance rates have student and parent populations which take school responsibilities seriously. It is also possible that students achieve more when they attend school regularly. A third possibility is that some school districts have the ability to provide the kind of atmosphere which encourages students to attend school regularly. Physical illness may even be more prevalent in one community than in another, and low attendance patterns would be expected.

The reading scores of younger students are highly related to eighth graders' BEST performance. Alternative explanations include the possibilities that: (1) School districts which successfully teach reading skills at lower grade

levels reap the benefits of having eighth graders with high-level reading skills. (2) Adequate reading skills are the most important predictor of success on all the BEST subtests. (3) Some school districts have students with higher abilities than other school districts, regardless of grade level, even when all other predictor variables are held constant.

Formula assessed valuation and the urban-rural seven-cell classification are important predictors of student performance. As expected, and as concluded by Nelson[41] in a 1980 study of Missouri BEST results, a wealthy community is able to provide more cultural and educational experiences for its young people than is a poor community. The significant correlation coefficient, computed within the design of the present study, between current expenditures per pupil and formula assessed valuation was +.591, suggesting the tendency for school districts with higher assessed valuation to spend more dollars in educating their pupils. The measure of average family income emerged as a significant predictor in seven regression equations. However, it was replaced by other variables in the expanded models, most frequently by the combination of ADC and the urban-rural classification. The replacement probably relates to the intercorrelation among variables. The initial predictive power of average family income supports the findings of Coleman, Dugan, Burkhead, Hettick, and Thomas.[42] The urban-rural classification is a highly significant predictor, supporting the results of Goodman's[43] 1958 study in New York state.

Based upon the correlation matrix developed as part of this present study, some descriptive conclusions are appropriate concerning rural-centered school districts: (1) Community income is lower. (2) Resident membership is lower. (3) Classification by the Missouri Department of Elementary and Secondary Education is lower. (4) Average certificated personnel salary is lower. However, size of a school district, in terms of student enrollment, emerges as a significant predictor only when the two largest districts and those with student en-

rollments under 100 have been eliminated for the equations. The positive sign for the partial regression coefficients indicates that higher performance is related to larger school district size.

In general, measures of the in-school environment of students, as specified in this model, did not show great predictive power. The most unexpected findings in this study related to the positive signs associated with the partial regression coefficients of the pupil/staff ratio. An examination of the raw data indicated that 32 districts had pupil/staff ratios less than 10 to 1, while 82 districts had ratios less than 12 to 1. The average pupil/staff ratio was 15.9 to 1, although the maximum was 42 to 1. A computer-produced scatter diagram revealed that the size of a school district and the pupil/staff ratio are related in a nonlinear fashion. In general, small school districts have pupil/staff ratios below the mean while larger districts have ratios above the mean.

It was concluded that the positive signs of the partial regression coefficients were possibly a reflection of a host of interrelated variables associated with the size of the school district. Since the pupil/staff ratio does not measure class size or even pupil/teacher ratio (because administrators and certificated support personnel are included in the computation of pupil/staff ratios), the composition of the school district staff may differ considerably between small and large districts. Research is needed to determine what other variables are associated with the pupil/staff ratio and with larger school districts which lead to the finding in this study. Specific recommendations for policy decisions are not appropriate based on the present finding because many factors are unknown. However, it is highly possible that some school districts could improve student performance on the BEST if some of their resources were reallocated. Inefficiencies may well exist which deter progress toward maximizing outcomes.

This study strongly suggests that students in Missouri who live in rural-centered school districts with formula assessed valuation and average family

income below the statewide average do not have an equal opportunity to pass and master the subtests for the Basic Essential Skills Test. The state school foundation financial aid formula, in itself, may succeed in better equalizing dollars spent for education. However, it is possible that these dollars are not sufficient to enable school districts to offer the kind of education which encourages and enables students to attain the skills measured on the BEST. Local school administrators and state policy makers must attempt to discover ways to assist rural students in developing minimal competencies.

Many educators do not wish to withhold high school diplomas from students who do not pass the BEST. This study reinforces that point of view. Until a strategy is found to provide all children with an equal opportunity to develop skills necessary to pass the minimum competency test, requiring the test for graduation may violate the principle of equity. Fortunately, Missouri does not have this graduation requirement at the present time.

Perhaps the implication of this study which is most significant for local administrators is the importance of devising methods to increase average daily attendance. Schools must become places in which students and staff enjoy spending time and feel that their efforts are worthwhile.

The fact that current expenditures per eligible pupil does not significantly account for variance in performance needs to be examined in future research. The lack of observed predictive power of school districts' total tax levy rates also calls into question conventional notions associated with citizens' willingness to pay for public education. The researchers developed and examined a comprehensive intercorrelation matrix which revealed no strong relationships between the total tax levy rate and any of the other independent variables or the criterion variables investigated in this study. If current expenditures and total tax levy rates seem unrelated to BEST performance, many of the current public policies toward education need further examination. What is to

be remembered, of course, is that performance on a minimal competency test is merely one of a myriad of outputs produced by schools. Current expenditures and total tax levy rates may be strongly associated with other important school outputs.

Researchers concerned with further developing an educational production function model that can directly aid policy makers should realize that an advancement in the state of the art can be made only by gathering data specific to pupils, and preferrably measures over time. This present exploratory study has identified and categorized, on the strength of empirical data analyses, major areas of out-of-school environment and peer characteristics that account for across-district variance in performance on a basic skills-minimum competency test. Further research about the in-school learning processes of individual pupils potentially will complement this study and add greatly to present knowledge, theory development, and solid bases for meaningful decisions by education's policy makers and curriculum designers.

NOTES

[1]This paper is based partially on data collected by Vera E. Freeman which appear in "Relationships Between School District Level Inputs and the Output Performance of Eighth Graders on the Missouri Basic Essential Skills Test," unpublished Ph.D. dissertation, University of Missouri-Columbia, 1980. The Freeman study is one of three completed to date as part of a comprehensive research map for the investigation of minimum competency testing, at the University of Missouri-Columbia by doctoral degree candidates in educational administration, under the supervision of Richard V. Hatley.

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